

SUPPORT FOR THE AMENDMENTS

The present amendment cancels claims 43, 45, 49 and 51, and amends claims 42, 47, 48, 50, 52 and 54-58.

Claims 47, 48, 50, 52 and 54-58 have been amended to place these claims in a better condition for allowance.

Support for the amendments to claim 42 is found at specification page 6, lines 4-6, page 10, lines 11-13, page 15, lines 5-8 and 22-23, page 26, lines 23-25, as well as claims 43, 45, 49 and 51.

It is believed that these amendments have not resulted in the introduction of new matter.

REMARKS

Claims 42, 44, 46-48, 50 and 52-59 are currently pending in the present application. Claims 43, 45, 49 and 51 have been cancelled, and claims 42, 47, 48, 50, 52 and 54-58 have been amended, by the present amendment.

The rejections under 35 U.S.C. § 103(a) of: (1) claims 42-44, 48-51 and 57-59 as being obvious over Nakai (JP 2001-080939) in view of Alumax (internet publication); (2) claim 45 as being obvious over Nakai in view of Alumax and Lewis (Hawley's Chemical Dictionary); (3) claim 46 as being obvious over Nakai in view of Alumax and Greenberg (U.S. 2002/0114945); (4) claims 47 and 52 as being obvious over Nakai in view of Alumax and Doushita (U.S. Patent 6,156,409); (5) claim 53 as being obvious over Nakai in view of Alumax and Niwa (U.S. Patent 6,408,743); and (6) claims 54-56 as being obvious over Nakai in view of Alumax and Chao (U.S. Patent 4,596,745), are respectfully traversed in part and obviated by amendment in part, with respect to claims 42, 44, 46-48, 50 and 52-59, which incorporates the limitations of claims 43, 45 and 51, as well as the limitation that the liquid comprises anatase-form titanium oxide particles and peroxytitanic acid, into claim 42.

Amended claim 42 recites a method for producing a glass sheet coated with an anatase-form titanium oxide thin film, wherein the method comprises: applying a liquid comprising anatase-form titanium oxide particles and peroxytitanic acid to a surface of a glass substrate, wherein the glass substrate is at a temperature of 150°C or lower, has a surface compressive stress of at most 10 MPa and comprises from 5 wt. % to 15 wt. % of an alkali metal; heating the surface coated with the liquid up to a maximum temperature of from 600°C to 700°C; maintaining the surface at a temperature of from 550°C to 700°C for a period of from 20 seconds to 500 seconds; and cooling the surface to a temperature of 200°C or lower by applying an air jet to both surfaces of the glass substrate under the condition satisfying formula (1) to thereby make the glass substrate have a surface compressive stress of from 20 MPa to 250 MPa:

$$0.2 \leq a/t^2 \leq 5 \text{ (1)}$$

wherein a represents the time (second) taken in cooling the surface from 500°C to 200°C, and t represents the thickness of the glass substrate (mm).

Applicants respectfully submit that contrary to pages 3-5 of the Official Action, a skilled artisan would not have been motivated to combine Nakai with the *clearly unrelated reference* of Alumax, since Nakai is directed to a process for producing an *annealed* glass by *gradual cooling* of the glass without applying cooling air to the surfaces thereof (See e.g., [0014]), whereas Alumax is directed to a process for producing a *tempered* glass by *rapid cooling* of the glass via application of cooling air to the surfaces thereof (See e.g., page 1). Since the annealed glass of Nakai is *fundamentally different* from the tempered glass of Alumax, a skilled artisan would neither have been motivated, nor had a reasonable expectation of success, to substitute the rapid cooling process of Alumax for the gradual cooling process of Nakai to arrive at the annealed glass of Nakai.

Applicants further submit that a skilled artisan would not have been motivated, nor had a reasonable expectation of success, to subsequently temper the anatase-form titanium oxide thin film covered annealed glass sheet produced by the process of Nakai because in order to temper the same, the edges of the glass sheet must first be cut and polished in order to prevent breakage during tempering. Prior to tempering, the surfaces of the cut and polished glass sheet must be then be brushed and washed to remove the glass powder that adhered on the surfaces thereof during cutting and polishing. However, brushing and washing damages the anatase-form titanium oxide thin film covering the annealed glass sheet, which after tempering, results in a tempered glass sheet having an inferior photocatalytic property to that exhibited by the glass sheet of the present invention.

Even if sufficient motivation and guidance is considered to exist for a skilled artisan to combine Nakai with the clearly unrelated reference of Alumax, a skilled artisan would not have arrived at the presently claimed invention because Alumax, Lewis, Greenberg, Doushita, Niwa and Chao, when considered alone or in combination, fail to compensate for the deficiencies of Nakai.

Unlike the liquid of the present invention, which comprises anatase-form titanium oxide particles and peroxytitanic acid, the titanate acid solution of Nakai contains only peroxytitanic acid (See e.g., abstract, claim 5, [0013]). Therefore, Nakai fails to disclose or suggest utilizing a liquid comprising both anatase-form titanium oxide particles and peroxytitanic acid, as presently claimed. As discussed in the present specification, by additionally containing anatase-form titanium oxide particles, the peroxytitanic acid present within the liquid is converted into anatase-form crystals in a shorter period of time during heating (See e.g., page 11, lines 23-25, page 12, line 1, page 13, lines 5-14). The claimed liquid also prevents alkali metal ions from diffusing into, and thereby significantly lowering the photocatalytic function of, the anatase-form titanium oxide thin film (See e.g., specification at page 14, lines 13-17, page 15, lines 5-10).

An additional distinction is that the liquid comprising anatase-form titanium oxide particles and peroxytitanic acid is applied to the surface of the glass substrate at a temperature of 150°C or lower in accordance with the method of the present invention (See e.g., specification at page 21, lines 16-19), whereas Nakai describes spraying a titanate acid solution to the surface of the glass substrate at a temperature of from 250°C to 600°C (See e.g., [0015]), which is clearly outside the claimed range of 150°C or lower. In addition, Greenberg describes spraying a metal oxide coating composition onto the surface of the glass substrate at a temperature sufficient for pyrolysis, and therefore does not disclose or suggest applying at the claimed temperature of 150°C or lower (See e.g., Greenberg at [0043]).

Nakai fails to disclose or suggest that the glass substrate comprises from 5 wt. % to 15 wt. % of an alkali metal, as presently claimed. Although Lewis describes a soda lime glass composition comprising 75 % silica (sand), 5 % lime (calcium oxide) and 20 % soda ash (sodium carbonate), Lewis fails to recognize the superior properties associated with utilizing an alkali metal in the claimed range of from 5 wt. % to 15 wt. %, which include, for example, reducing the modulus of elasticity of the glass substrate to thereby promote the selective growth of anatase-form

crystals thereby improving surface compressive stress of the glass substrate and abrasion resistance of the anatase-form titanium oxide thin film (See e.g., specification at page 15, lines 22-23, page 16, lines 1-11).

In the method of the present invention, the liquid coated surface is heated up to a maximum temperature of from 600 to 700°C in order to provide sufficient toughness and adhesiveness (See e.g., specification at page 25, lines 1-22). Although Nakai describes spraying a titanate acid solution to the surface of the glass substrate at a temperature of 250 to 600°C (See e.g., [0012], [0015]), Nakai fails to describe heating the coated surface to the claimed temperature of from 600 to 700°C. Moreover, since the surface temperature of the glass substrate of Nakai immediately decreases upon spraying the titanate acid solution thereon, the surface temperature is not adequate for providing sufficient toughness and adhesiveness.

In the method of the present invention, the liquid coated surface is maintained at a temperature of from 550°C to 700°C for a period of from 20 seconds to 500 seconds in order to provide an anatase-form titanium oxide thin film having sufficient toughness, adhesiveness and photocatalytic function, as well as to prevent deformation of the glass substrate, prevent the diffusion of alkali metal ions into the anatase-form titanium oxide thin film and prevent the formation of rutile-form crystals (See e.g., specification at page 10, lines 11-18, page 26, lines 23-25, page 27, lines 1-15). Although Nakai describes spraying a titanate acid solution to the surface of the glass substrate at a temperature of 250 to 600°C (See e.g., [0012], [0015]), Nakai fails to describe maintaining the liquid coated surface at a temperature of from 550°C to 700°C for a period of from 20 seconds to 500 seconds, as presently claimed. Nakai also fails to recognize the previously discussed advantages associated therewith.

Unlike the claimed cooling technique of the present invention, which involves rapid cooling of the liquid coated surface of the glass substrate to a temperature of 200°C or lower by applying an air jet to both surfaces of the glass substrate under the condition satisfying the formula (1), the glass

substrate of Nakai is gradually cooled without applying cooling air to both surfaces thereof (See e.g., [0014]). In addition, Alumax describes that the glass substrate is rapidly cooled, via the application of cooling air to both surfaces thereof, to a temperature of from 400°F to 600°F (i.e., from 204°C to 315°C), which is clearly outside the claimed temperature range of 200°C or lower.

Therefore, Nakai, Alumax, Lewis, Greenberg, Doushita, Niwa and Chao, when considered alone or in combination, fail to disclose or suggest the presently claimed method.

Assuming *arguendo* that sufficient motivation and guidance is considered to have been provided by Nakai, Alumax, Lewis, Greenberg, Doushita, Niwa and/or Chao to direct a skilled artisan to arrive at the presently claimed invention, which is clearly not the case, such a case of obviousness is rebutted by a showing of superior properties.

As evidenced by the experimental data presented in the present specification, superior properties with respect to surface compressive stress, strength and adhesiveness are remarkably exhibited by glass sheets coated with an anatase-form titanium oxide thin film produced by a method in accordance with the present invention.

As discussed in the present specification, Applicants have discovered that the rapid cooling technique of the claimed method enables the glass substrate to retain its surface compressive stress when the condition formula (1) is satisfied, thereby increasing the strength of the glass substrate and improving the adhesiveness of the titanium oxide thin film formed on the surface thereof (See e.g., specification at page 27, lines 16-22, and page 28, lines 2-15).

As demonstrated by the experimental data presented in Example 1, the glass sheet coated with an anatase-form titanium oxide thin film produced by a method in accordance with the present invention remarkably exhibited a surface compressive stress of 104 MPa, as well as improved strength and adhesiveness, as evidenced by the pencil hardness test, whereby the titanium oxide thin film formed on the surface of the glass substrate did not peel away despite having been rubbed

with a pencil having a hardness of 6H (See e.g., Example 1 at page 40, lines 5-22, page 42, lines 8-17, and page 43, lines 11-16).

Similar to the glass substrate of Nakai, Example 4 failed to satisfy the condition of formula (1) because the surface of the glass substrate was gradually cooled with no cooling air being applied thereto. As a result, the glass sheet coated with an anatase-form titanium oxide thin film exhibited a surface compressive stress of nearly 0 MPa, as well as inferior strength and adhesiveness properties, as evidenced by the pencil hardness test, whereby the titanium oxide thin film formed on the surface of the glass substrate completely peeled away after having been rubbed with a pencil having a hardness of only 2H (See e.g., Example 4 at page 46, lines 12-25, page 47, lines 1-7 and 18-23, and page 48, lines 11-16).

This evidence clearly demonstrates that the method of the present invention produces a glass sheet coated with an anatase-form titanium oxide thin film that remarkably exhibits superior properties with respect to surface compressive stress, strength and adhesiveness, as compared to the inferior properties exhibited by glass sheets coated with an anatase-form titanium oxide thin film produced by conventional methods.

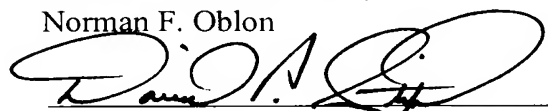
Withdrawal of these grounds of rejection is respectfully requested.

The rejection of claims 42-59 under 35 U.S.C. § 112, second paragraph, is obviated by the amendment to claim 42. Withdrawal of this ground of rejection is respectfully requested.

In conclusion, Applicants submit that the present application is now in condition for allowance and notification to this effect is earnestly solicited.

Respectfully submitted,

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